EUROPEAN JOURNAL OF PUBLIC HEALTH 2004; 14: 123–127
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Age and quality of in-hospital care of patients with heart failure

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Background: Elderly patients may be at risk of suboptimal care. Thus, the relationship between age and quality of care for patients hospitalized for heart failure was examined. Methods: A cross-sectional study based on retrospective chart review was performed among a random sample of patients hospitalized between 1996 and 1998 in the general internal medicine wards, with a principal diagnosis of congestive heart failure, and discharged alive. Explicit criteria of quality of care, grouped into three scores, were used: admission work-up (admission score); evaluation and treatment during the stay (evaluation and treatment score); and readiness for discharge (discharge score). The associations between age and quality of care scores were analysed using linear regression models. Results: Charts of 371 patients were reviewed. Mean age was 75.7 (±11.1) years and 52% were men. There was no relationship between age and admission or readiness for discharge scores. The evaluation and treatment score decreased with age: compared with patients less than 70 years old, the score was lower by −2.6% (95% CI: −7.1 to1.9) for patients aged 70 to 79, by −8.7% (95% CI: −13.0 to −4.3) for patients aged 80 to 89, and by −19.0% (95% CI: −26.6 to −11.5) for patients aged 90 and over. After adjustment for possible confounders, this relationship was not significantly modified. Conclusions: In patients hospitalized for congestive heart failure, older age was not associated with lower quality of care scores except for evaluation and treatment. Whether this is detrimental to elderly patients remains to be evaluated.

Keywords: age, congestive heart failure, quality of care

Older patients tend to receive in-hospital treatments proven to lower mortality less frequently than younger patients. This has been shown for several acute cardiac conditions, such as unstable angina pectoris,[1] myocardial infarction,[2–4] as well as for chronic cardiac diseases, such as treatment after myocardial infarction[5–7] or heart failure.[8,9] A similar negative influence of age has been reported for the use of hemodialysis and kidney transplantation among patients with end-stage renal failure.[10,11] Lower use of effective therapies among the elderly occurs even though these patients are at higher risk of mortality and morbidity,[12] and even though survival benefits of effective treatments in older and younger patients are often equivalent.[13,14]

Whether in-hospital care of elderly patients is only less intensive, or generally worse than that of younger patients, remains unclear. We addressed this question by applying explicit criteria of quality of hospital care[15] to charts of patients hospitalized for congestive heart failure, the most frequent diagnosis related group in the Department of Internal Medicine of our hospital.

METHODS

Setting and patients

This study was conducted in the general internal medicine wards of the University Hospitals of Geneva, Switzerland. This 1200-bed urban public hospital is the main community and teaching hospital for the area. Because of limited resources, not all patient charts could be reviewed. We therefore drew a random sample of 371 patient records from the 1084 patients discharged alive with a principal diagnosis of congestive heart failure admitted between 1 January 1997 and 31 December 1998.[16] Patients were identified using ICD9 – CM codes 398.91; 402.01; 402.11; 402.91; 404.01; 404.03; 404.11; 404.13; 404.91; 404.93; and 428.[17]

Outcome variables

The main outcome variable was the quality of in-hospital care measured by means of explicit criteria developed by Ashton *et al.*[15] (the criteria are available at http://www.medinter.ch/grassh). The criteria were divided into three subgroups corresponding to successive hospitalization phases: 1) admission work-up (history, physical examination and initial tests); 2) evaluation and treatment during the stay; and 3) readiness for discharge. As many criteria were not applicable to all patients, we calculated the proportion of fulfilled criteria among those applicable to each hospitalization phase. Thus, three quality scores were obtained corresponding to each phase of the hospital stay: an admission score, an evaluation and treatment score, and a discharge score. All information was abstracted from patient charts by a trained nurse.

Predictor variables

The main risk factor analysed was patient age. Other predictors of quality of care included: 1) socio-demographic data: gender, and whether the patient lived alone; 2) medical data: known diagnosis of congestive heart failure, hypertension, diabetes, history of acute myocardial infarction, cardiac revascularization by percutaneous transluminal coronary angioplasty or coronary artery bypass grafting, and intubation during the stay; and 3) admission physical and laboratory findings: systolic blood pressure, heart rate, serum sodium, plasma creatinine, rhythm and/or ST-T wave changes on admission electrocardiogram, and cardiac ejection fraction. Cardiac ejection fraction measurement was available in only 172 patients. Comorbidities were assessed and scored according to Charlson *et al.*[18]

Statistical analysis

The association between the proportion of quality of care criteria met in each score and age was explored using locally weighted smoothing scatterplots (LOWESS).[19] On this basis, only the

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score for which an association with age was observed was further analysed. The influence of patients' demographic and clinical characteristics on the proportion of quality of care criteria fulfilled was assessed by univariate linear regression. Based on graphical analyses, age was categorized as follows: less than 70 years; 70 to 79 years; 80 to 89 years; and 90 years and over.

Variables reflecting patients' demographic and clinical characteristics that were significantly associated with quality of care in univariate analysis were incorporated into a multivariate model. Multiple linear regression analysis was used to evaluate the association between quality of care and the independent variables. Two-way interactions between age and other risk factors were tested as well. Backward elimination was then used until all remaining variables in the model reached a significance level of 0.05 or less. The significance of associations between age and observance of quality of care criteria was tested by trend tests.[20]

RESULTS

A total of 371 patients were included. Mean patient age was 75.7 years (± 11.1). Older patients were more likely to be women *(table 1)* and to live alone, and less likely to have a history of myocardial revascularization, myocardial infarction or diabetes mellitus. Older patients were also less often admitted to an intensive care unit, and they had a significantly lower mean Charlson comorbidity index.

Age was not associated with the admission score *figure 1(a)*. The pattern of association was inconsistent for the discharge score *figure 1(c)*. However, the evaluation and treatment score clearly decreased with patient age *figure 1(b)*. Further analyses were therefore conducted for the latter score only. The mean evaluation and treatment score during the stay was 66.1% (SD=17.2%). In unadjusted analyses *(table 2)*, a better quality of care during the stay was positively associated with a history of myocardial revascularization, a faster heart rate on admission, intubation during the hospital stay, and a longer length of stay.

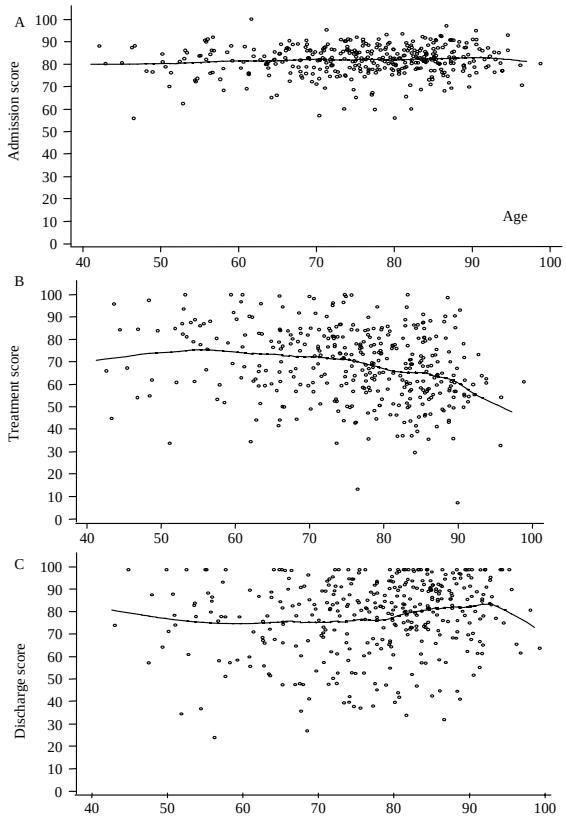

Figure 1 Relationship between age and the proportion of quality of care criteria met for a) admission work-up; b) evaluation and treatment during the stay; and c) readiness for discharge, among 371 patients discharged alive with a main diagnosis of congestive heart failure from Geneva University Hospitals, 1999

Table 1 Characteristics of the patient sample by age groups

	Age (years) n (%)				
	<70 n=95	70–79 n=116	80–89 n=137	≥90 n=23	p-value
Men	71 (74%)	61 (53%)	55 (40%)	7 (30%)	<0.001
Living alone	35 (39%)	48 (42%)	75 (57%)	12 (52%)	0.04
Known prior congestive heart failure	38 (41%)	57 (49%)	50 (38%)	11 (52%)	0.30
History of revascularisation	25 (26%)	34 (29%)	8 (6%)	0	<0.001[a]
History of myocardial infarction	29 (31%)	51 (44%)	42 (31%)	4 (17%)	0.03
Known hypertension	49 (52%)	73 (63%)	72 (53%)	19 (43%)	0.18
Known diabetes mellitus	23 (24%)	34 (29%)	28 (20%)	1 (4%)	0.04
Hypotension on admission	8 (8%)	6 (5%)	7 (5%)	0	0.51[a]
Hyponatremia on admission	10 (11%)	13 (11%)	33 (24%)	4 (17%)	0.01
Serum creatinine >265.2 μmol/l on admission	8 (9%)	5 (4%)	3 (2%)	0	0.11[a]
Non-sinus cardiac rhythm on admission	28 (29%)	42 (36%)	52 (39%)	9 (41%)	0.50
Mean heart rate on admission (bpm ±SD)	98 (28)	89 (22)	92 (24)	92 (19)	0.08[b]
Mean systolic blood pressure on admission (mmHg ±SD)	141 (30)	149 (32)	148 (28)	154 (25)	0.11[b]
New ST-T changes on admission	41 (46%)	55 (53%)	70 (56%)	13 (62%)	0.38
Admission to an intensive care unit	24 (25%)	23 (20%)	17 (12%)	1 (4%)	0.02[a]
Intubation during the stay	4 (4%)	7 (6%)	2 (1%)	0	0.20[a]
Mean Charlson comorbidity index (points ±SD)	2.8 (2.2)	3.1 (2.2)	2.3 (2.0)	1.8 (1.8)	0.004[b]
Mean length of stay (days ± SD)	12.8 (10.1)	14.2 (10.0)	12.5 (6.0)	13.7 (7.0)	0.48[b]
Mean ejection fraction (% ±SD) (n=172)	32 (12)	34 (11)	37 (11)	45 (0)	0.17[b]

Chi square test except
a: Exact test
b: Analysis of variance

In multivariate analyses *(table 3)*, the evaluation and treatment score was positively associated with a longer length of stay, and remained negatively associated with age.

The association with age varied from one criterion of quality to the next *(table 4)*. Age had a gradual negative association with the performance of an echocardiogram, the measurement of the ejection fraction if it was previously unknown, the measurement of creatinine clearance if a renal insufficiency appeared or worsened during hospitalization, and with a transfer to an intensive care unit in case of severe or prolonged chest pain. Among the other criteria unrelated to age, two patterns were seen. A first category (criteria 6 to 13 in *table 4)* concerned criteria that were mainly respected during the hospital stay, with a proportion of eligible patients in which the criteria were fulfilled exceeding 60%. The second category (criteria 14 to 19 in *table 4)* included quality of care criteria that were met by 50% or less of the eligible patients, regardless of age.

DISCUSSION

Our study showed that, among patients hospitalized for congestive heart failure, older age was associated with lower scores assessing the completeness of evaluation and treatment during their stay. Compared with patients less than 70 years old, significant differences were present for the 80 to 89 years of age group, and even more for the 90 and over age group. These differences persisted after adjustment for clinical characteristics and comorbidities. In contrast, admission and discharge scores bore no relationship with age.

The fact that two out of three quality of care scores were not related to age is reassuring. Nevertheless, the findings of a less complete medical evaluation and treatment among the elderly are disturbing. The prevalence of congestive heart failure increases with age,[21] as do hospital admissions for this medical condition,[22,23] and effective treatments reduce mortality and morbidity even among very old patients.[24–27]

Analysis of the fulfilment of each individual criterion of evaluation and treatment according to age reveals that the first five criteria in *table 4*, mostly reflecting evaluation, were less and less observed as age increased. This was particularly true for tests assessing the severity, the type (systolic or diastolic) and the causes of heart failure. These omissions may be deleterious to older patients, since this information is likely to influence treatment, regardless of age.[28] On the other hand, invasive investigations, such as cardiac catheterization, are more likely to

Table 2 Univariate associations between independent variables and evaluation and treatment score

Covariate	Difference in evaluation and treatment score	95% CI	p-value
Age category			
<70 years	Reference	–	–
70–79 years	–2.59	–7.08 – 1.89	0.26
80–89 years	–8.67	–12.99 – –4.34	<0.001
≥90 years	–19.03	–26.56 – –11.50	<0.001
Male sex	2.96	–0.54 – 6.46	0.09
Living alone	–0.66	–4.25 – 2.93	0.72
Known prior congestive heart failure	1.85	–1.77 – 5.48	0.32
History of revascularisation	5.30	0.76 – 9.83	0.02
History of myocardial infarction	0.64	–3.07 – 4.35	0.73
Known hypertension	0.64	–2.88 – 4.18	0.72
Known diabetes mellitus	0.82	–3.34 – 4.98	0.70
Hypotension on admission	0.33	–7.25 – 7.91	0.93
Hyponatremia on admission	–3.18	–7.95 – 1.58	0.19
Serum creatinine >265.2 µmol/l on admission	2.24	–6.41 – 10.89	0.61
Non-sinus cardiac rhythm on admission	1.97	–1.68 – 5.63	0.29
Heart rate on admission (for 10 bpm increase)	0.8	0.10 – 1.53	0.03
Systolic blood pressure on admission (for 10 mmHg increase)	–0.16	–0.75 – 0.43	0.59
New ST-T changes on admission	1.57	–2.70 – 5.24	0.40
Intubation during the stay	7.85	0.57 – 15.13	0.04
Charlson comorbidity index (for 1 pt increase)	–0.15	–0.97 – 0.68	0.73
Ejection fraction (n=172) (for 10% improvement)	–1.62	–3.53 – 0.28	0.09
Length of stay (for each additional day)	0.48	0.29 – 0.68	<0.001

Table 3 Multivariate association between independent variables and evaluation and treatment score

Covariate	Difference in the proportion of fulfilled criteria	95% CI	p-value
Age category			
<70 years	Reference	–	–
70–79 years	–3.26	–7.60 – 1.09	0.14
80–89 years	–8.54	–12.73 – –4.35	<0.001
≥90 years	–19.47	–26.76 – –12.17	<0.001
Length of stay (per day)	0.48	0.29 – 0.66	<0.001

be refused by older patients because they logically lead to invasive procedures, such as percutaneous or surgical interventions; in addition, physicians may be reluctant to offer such investigations to elderly patients, because of their frailty or because of their shorter life expectancy. The fulfilment of the other criteria was stable when reported to patients' age, but none of the criteria were fulfilled more thoroughly among older patients than among younger ones.

Like others,[1,29] we found that older patients were less frequently transferred to an intensive care unit in the case of severe or prolonged chest pain. In hospital, mortality of acute myocardial infarction patients is highest among the elderly.[30,31] Even though age is a risk factor for increased mortality in the intensive care unit after a myocardial infarction,[32] transfer to such a unit still improves survival among patients aged 70 or more when compared to standard care in internal medicine wards.[33] There is no evidence suggesting that age alone should lower transfer rate to an intensive care unit. Since our sample included only patients discharged alive, we could not determine if this less intensive management of severe chest pain had an impact on in-hospital mortality. However, the assumption that older patients had more comorbidities than younger patients, and therefore were less eligible for admission to the intensive care unit, cannot be an explanation for such decisions. Indeed, the Charlson comorbidity index at admission was lowest among the oldest patients. This may be explained by a greater likelihood of the fittest reaching old age.[34] Alternative explanations would be an incomplete coding of secondary diagnoses, a known problem among older patients,[35] or coding of another principal diagnosis than congestive heart failure in the presence of multiple co-existing diseases.

Unlike other studies,[8,9] we did not find a significantly lower use of effective pharmaceutical therapies among the oldest patients. Nevertheless, there was a trend for lower use of vasodilator therapy.

Our study had several limitations. Whether the criteria of quality of care developed by Ashton *et al.* are best suited to the oldest patients can be questioned. Most clinical trials of heart failure management exclude the oldest and the sickest patients.[36,37] Therefore, the conclusions of such trials, on which expert knowledge is at least partly built, may not fully apply to the oldest people. The Ashton criteria are maximalist in that they aim to determine whether a desirable investigation or treatment was completed. However, depending on the clinical situation, therapeutic or investigative abstention may be justified. The reasons for such abstentions or omissions, as well as their impact on patients' clinical outcomes or quality of life after hospital discharge, have not been analysed in our study, except for hospital readmission, for which no association with evaluation and treatment scores was found.[16] Whether investigative abstention on the basis of poor prognosis is justified deserves further research requiring, on the one hand, the elaboration of explicit criteria of appropriateness of such abstention due to coexisting life threatening diseases, functional limitations or cognitive impairment, and, on the other hand, a survey of patients after discharge.

In conclusion, in-hospital management of heart failure was found to be less complete for elderly patients than for younger patients, according to an available set of explicit criteria. Physicians should be aware of these differences and of the fact that age by itself neither implies a poor prognosis nor is it a contraindication for the use of effective therapy.

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Table 4 Association between patients' age and the proportion of patients for which individual quality of care criteria were fulfilled

Criteria included in the evaluation and treatment score	Eligible patients	Proportion of patients with the criterion fulfilled				
		<70	70–79	80–89	≥90	p-value[a]
Echocardiogram	310	94.3	78.4	62.3	13.3	<0.001
Ejection fraction measured	369	72.3	57.4	35.0	0	<0.001
Transfer to an intensive care unit	73	86.7	71.4	32.4	33.3	<0.001
24 hour creatinine clearance	74	69.2	57.9	29.4	12.5	0.001
Cardiac catheterisation	71	85.3	96.0	50.0	–[b]	0.05
Oxygen supplied	330	98.8	100	99.2	100	0.69
Potassium-sparing diuretic not given	89	95.2	87.0	91.7	88.9	0.69
Use of digoxin	59	94.4	88.5	85.7	100	0.51
Vasodilatator therapy given	329	90.0	89.3	83.9	77.8	0.08
Low dose heparin or full-dose anticoagulation	347	87.4	88.9	89.9	91.3	0.49
24 hour electrocardiogram	33	83.3	66.7	64.3	0	0.22
Daily weights obtained	368	83.2	89.6	85.9	82.6	0.88
Potassium supplement given	86	82.4	82.1	93.6	60.0	0.65
Low salt diet	365	52.2	53.0	46.7	47.8	0.38
Activity restricted	364	48.9	54.4	57.8	47.8	0.41
Thyroid function tests	369	45.2	50.4	50.4	50.0	0.50
24 hour proteinuria	120	40.6	24.2	25.0	14.3	0.10
Dietary consultation	58	27.8	13.3	25.0	0	0.41
Diagnostic thoracocentesis	146	22.2	18.2	22.3	12.5	0.70

a: Linear trend test
b: No eligible patient

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Received 11 March 2002, accepted 3 February 2003